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(54) **LIGHT EMITTING ELEMENT AND LIGHT
EMITTING DEVICE**

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H01L 33/20 (2010.01)

H01L 33/00 (2010.01)

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CPC **H01L 33/20** (2013.01); **H01L 33/0079**
(2013.01); **H01L 33/56** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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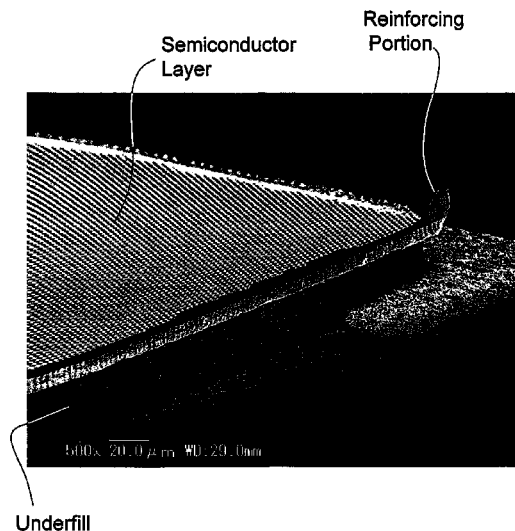
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(57) **ABSTRACT**

A light emitting element has a semiconductor layer, a pair of positive and negative electrodes, and a reinforcing portion. The pair of positive and negative electrodes is disposed on a lower face side of the semiconductor layer. The pair of electrodes is connected to the substrate. The reinforcing portion is disposed on an outer edge part of an upper face of the semiconductor layer. The reinforcing portion is made from a light-transmissive material. The upper face includes an exposed portion exposed from the reinforcing portion.

17 Claims, 8 Drawing Sheets



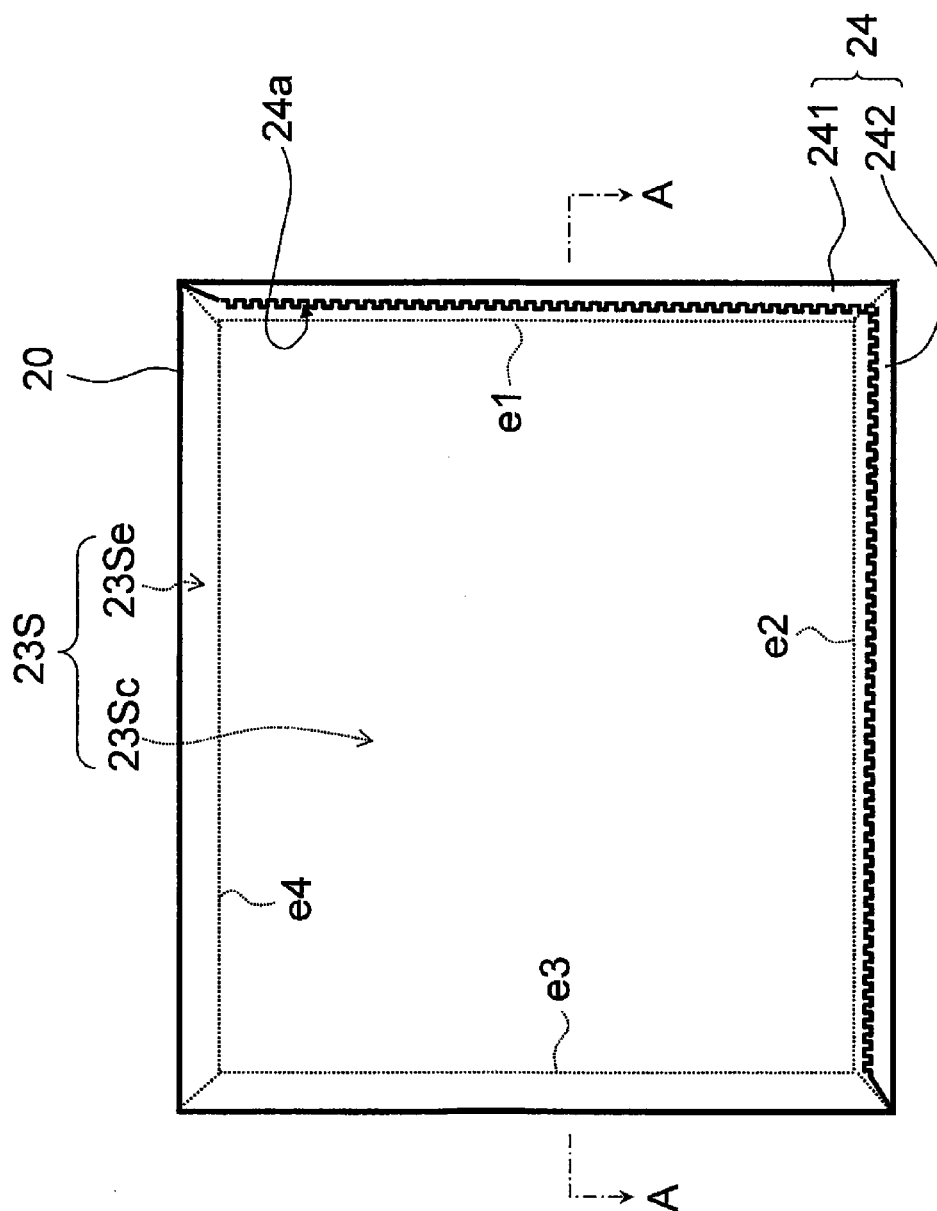


FIG. 1

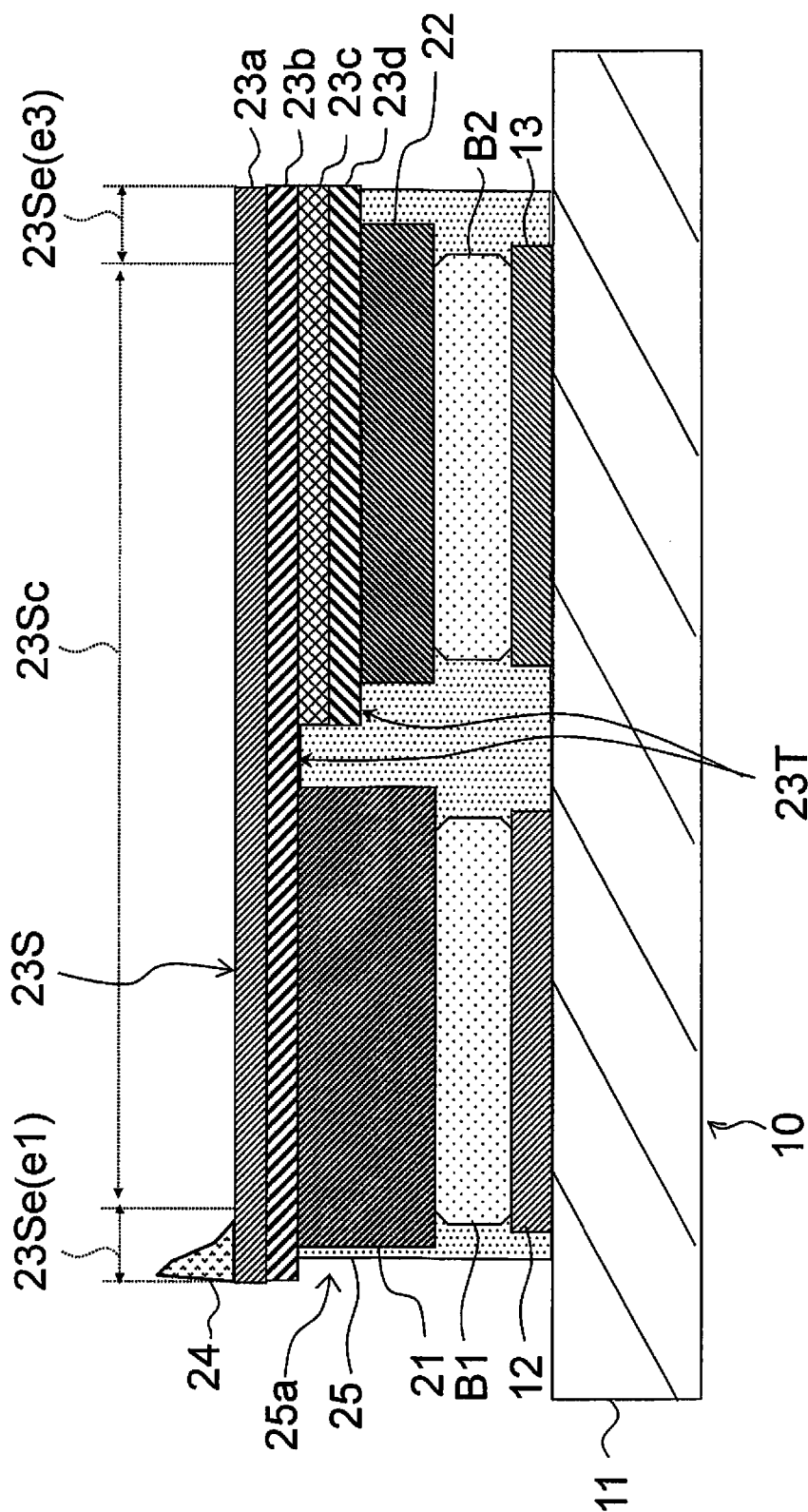


FIG. 2

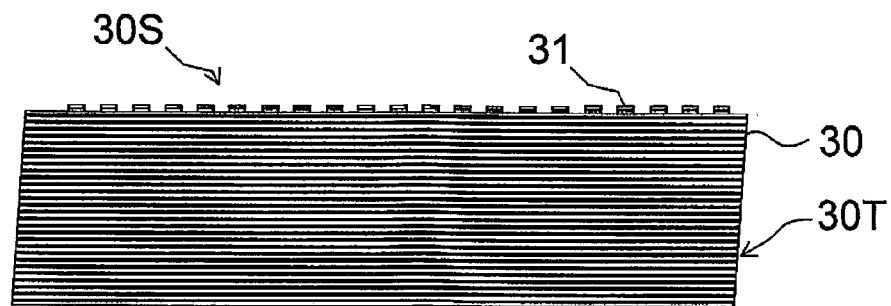


FIG. 3A

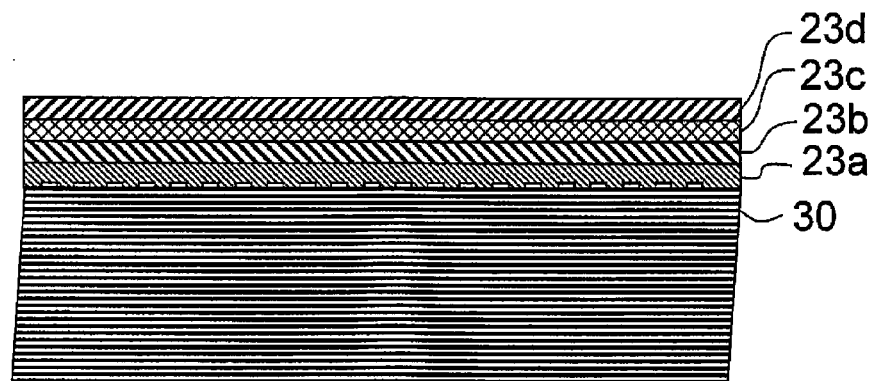


FIG. 3B

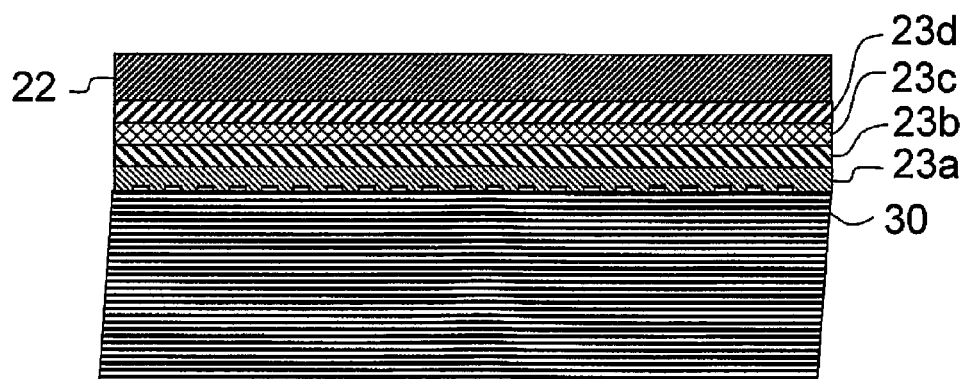


FIG. 3C

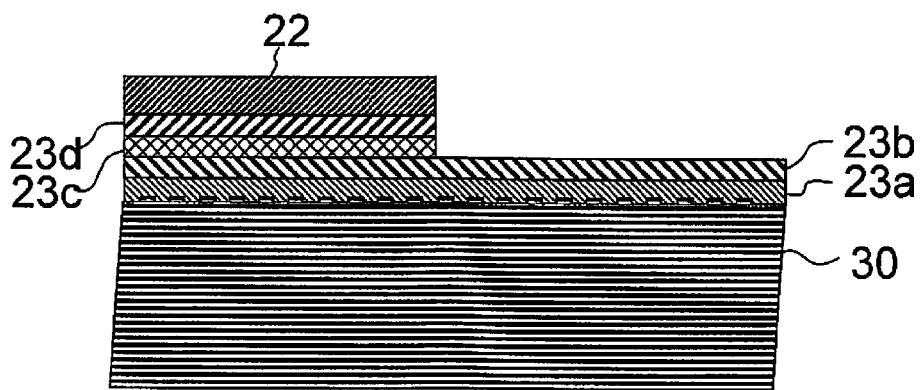


FIG. 4A

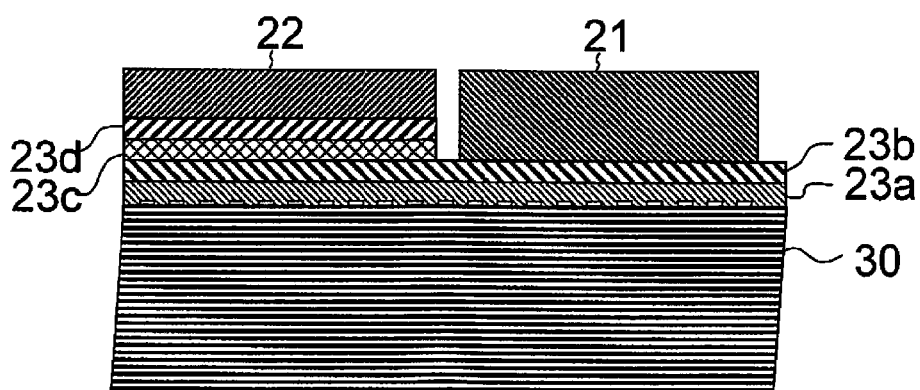


FIG. 4B

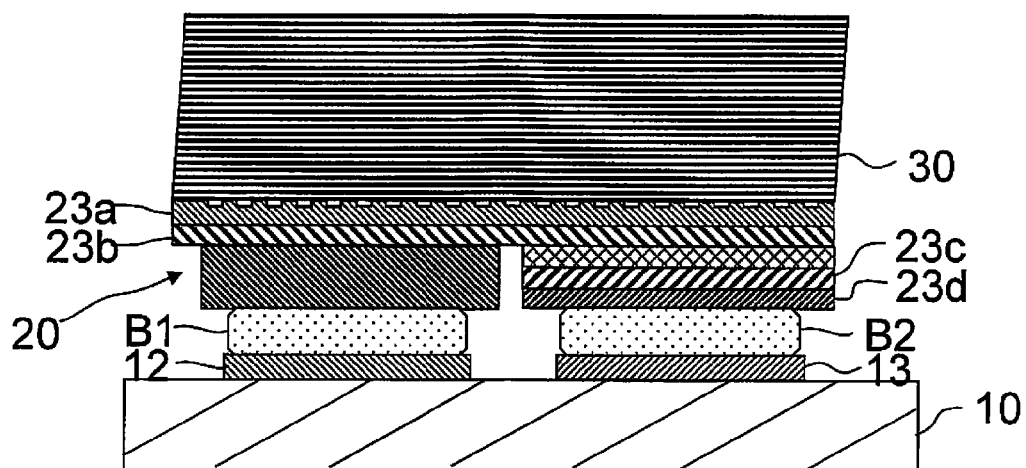


FIG. 4C

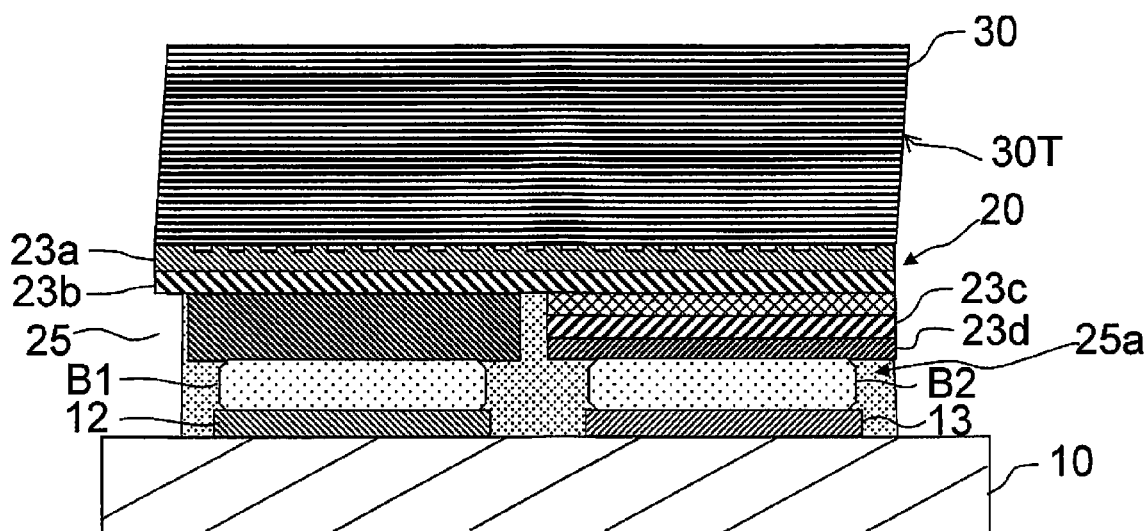


FIG. 5A

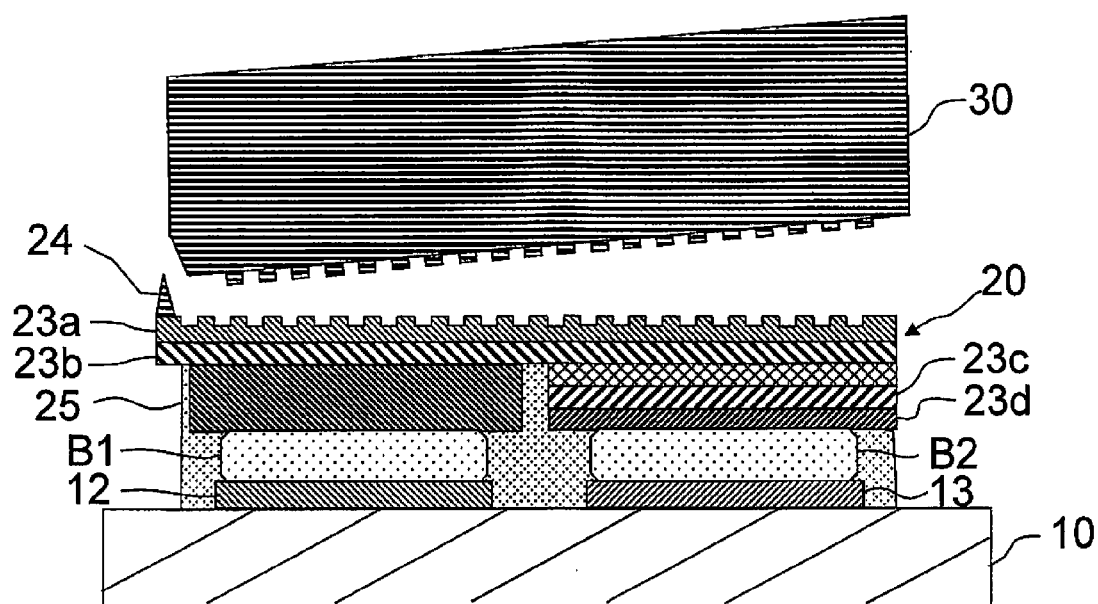


FIG. 5B

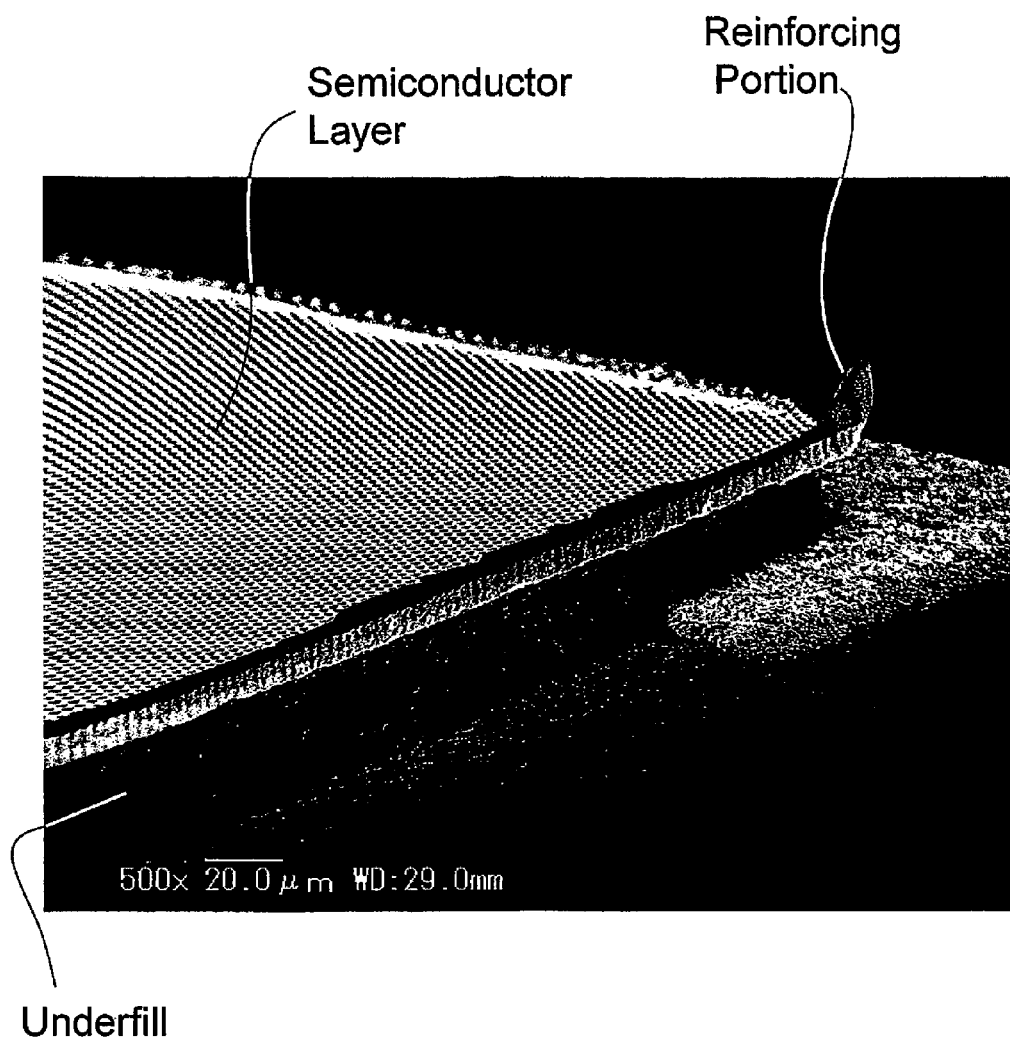


FIG. 6

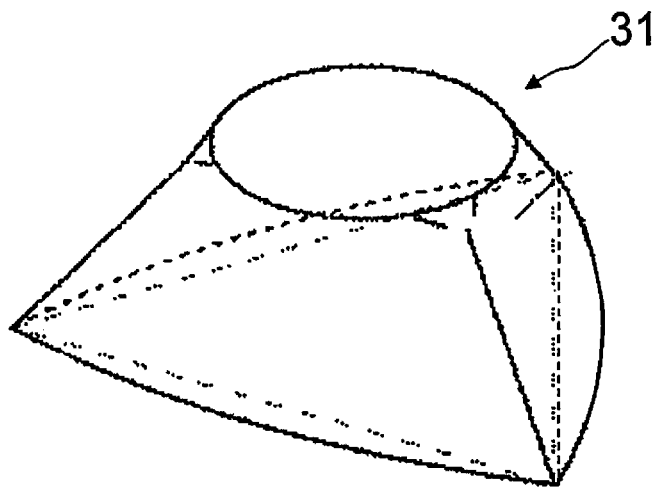


FIG. 7

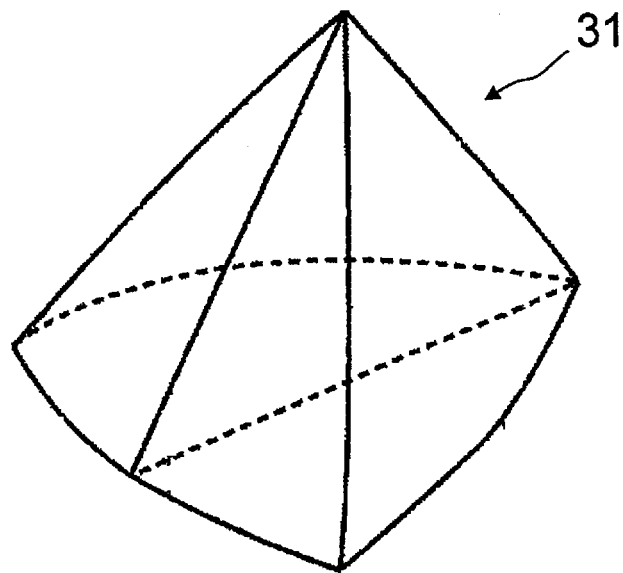


FIG. 8

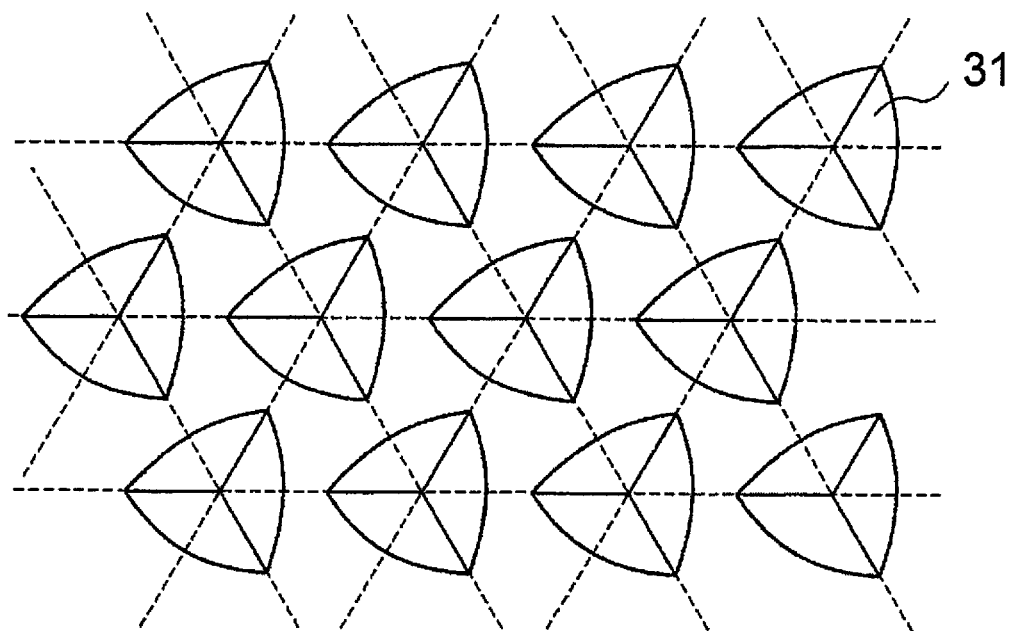


FIG. 9

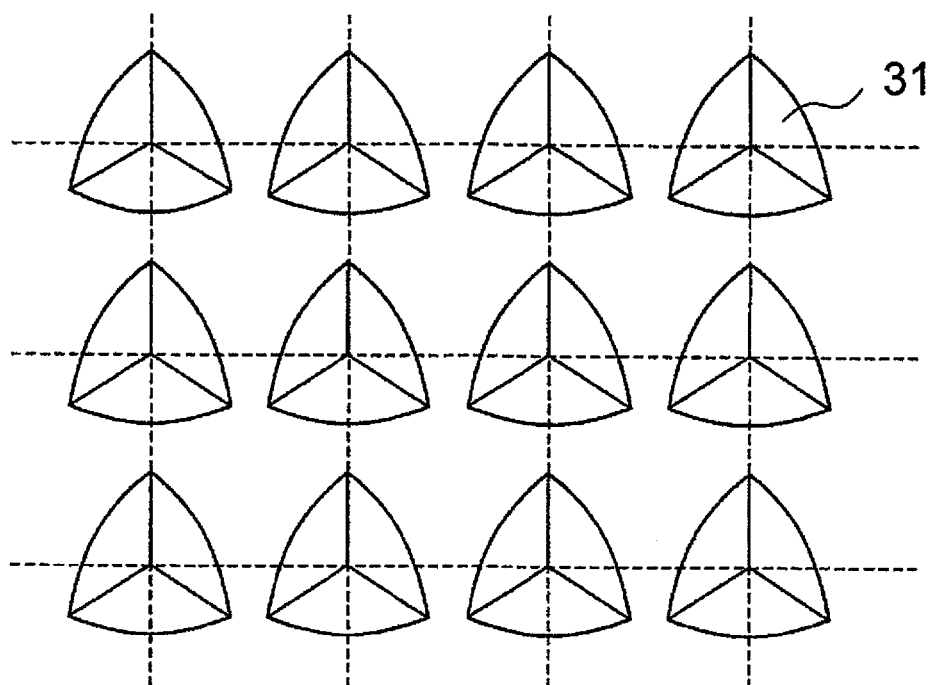


FIG. 10

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LIGHT EMITTING ELEMENT AND LIGHT EMITTING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to Japanese Patent Application No. 2013-137235, filed on Jun. 28, 2013. The entire disclosure of Japanese Patent Application No. 2013-137235 is hereby incorporated herein by reference.

BACKGROUND

1. Field of the Invention

The present disclosure relates to a light emitting element and a light emitting device.

2. Background Art

Light emitting elements comprising electrodes connected to a substrate, and a semiconductor layer disposed on the electrodes were known in the past (see Japanese Laid-Open Patent Application 2006-128710, for example).

SUMMARY

A light emitting element according to the embodiments of the invention has at least a semiconductor layer, a pair of positive and negative electrodes, and a reinforcing portion. The pair of positive and negative electrodes is disposed on a lower face side of the semiconductor layer. The pair of electrodes is connected to a substrate. The reinforcing portion is disposed on an outer edge part of an upper face of the semiconductor layer. The reinforcing portion is made from a light-transmissive material. The upper face includes an exposed portion exposed from the reinforcing portion.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a schematic plan view of the configuration of a light emitting device according to an embodiment;

FIG. 2 is a schematic cross section along the A-A line in FIG. 1;

FIG. 3A is a schematic diagram illustrating a method for manufacturing the light emitting element according to an embodiment;

FIG. 3B is a schematic diagram illustrating the method for manufacturing the light emitting element according to an embodiment;

FIG. 3C is a schematic diagram illustrating the method for manufacturing the light emitting element according to an embodiment;

FIG. 4A is a schematic diagram illustrating the method for manufacturing the light emitting element and a light emitting device according to an embodiment;

FIG. 4B is a schematic diagram illustrating the method for manufacturing the light emitting element and the light emitting device according to an embodiment;

FIG. 4C is a schematic diagram illustrating the method for manufacturing the light emitting element and the light emitting device according to an embodiment;

FIG. 5A is a schematic diagram illustrating the method for manufacturing the light emitting element and the light emitting device according to an embodiment;

FIG. 5B is a schematic diagram illustrating the method for manufacturing the light emitting element and the light emitting device according to an embodiment;

FIG. 6 is an SEM image of a reinforcing portion according to an embodiment;

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FIG. 7 is a schematic oblique view of the configuration of a convex portion on a sapphire substrate surface according to an embodiment;

FIG. 8 is a schematic oblique view of the configuration of the convex portions on the sapphire substrate surface according to an embodiment;

FIG. 9 is a schematic plan view of the layout of a plurality of convex portions on the sapphire substrate surface according to an embodiment; and

FIG. 10 is a schematic plan view of the layout of a plurality of convex portions on the sapphire substrate surface according to an embodiment.

DETAILED DESCRIPTION

With the traditional light emitting element, a resin layer or the like is sometimes formed on the semiconductor layer in post-processing. In this case, there is the risk that pressure exerted on the semiconductor layer will damage the end of the semiconductor layer.

The embodiments of the present invention are conceived in light of the above situation, and it is an object thereof to provide a light emitting element and a light emitting device with which damage to the end of the semiconductor layer can be suppressed.

Next, embodiments of the present invention will now be described through reference to the drawings. In the description of the drawings, portions that are the same or similar will be numbered in the same or similar ways. These drawings are just schematics, however, and dimensional proportions and so forth may differ from those in actual practice. Therefore, specific dimensions and the like should be determined by referring to the description. Naturally, there are portions in which the dimensional relations and proportions vary from one drawing to the next.

Configuration of Light Emitting Element 20 and Light Emitting Device 100

The configuration of the light emitting element 20 and the light emitting device 100 pertaining to an embodiment will be described through reference to the drawings. FIG. 1 is a schematic plan view of the configuration of the light emitting device 100. FIG. 2 is a schematic cross section of the light emitting device 100 along the A-A line in FIG. 1.

The light emitting device 100 comprises at least one substrate 10 and at least one light emitting element 20.

As shown in FIG. 2, the substrate 10 may have at least a substrate main body 11, an n-side wiring electrode 12, and a p-side wiring electrode 13. The substrate main body 11 is made of an electrically insulating material. A glass epoxy, silicone glass, alumina, aluminum nitride, or another such ceramic, or the like can be used as this electrically insulating material. The n-side wiring electrode 12 and the p-side wiring electrode 13 are disposed on at least a main face 11S of the substrate main body 11. The n-side wiring electrode 12 and the p-side wiring electrode 13 are each connected to conductive wiring used for external connections.

As shown in FIGS. 1 and 2, the light emitting element 20 has at least an n-side electrode 21, a p-side electrode 22, a semiconductor layer 23, and a reinforcing portion 24. The n-side electrode 21 and the p-side electrode 22 are an example of the "pair of positive and negative electrodes."

As shown in FIG. 2, the n-side electrode 21 and the p-side electrode 22 are disposed on a lower face 23T side of the semiconductor layer 23. The n-side electrode 21 can be connected to the n-side wiring electrode 12 via a gold bump B1, for example. The p-side electrode 22 can be connected to the p-side wiring electrode 13 via a gold bump B2, for example.

The light emitting element **20** and the substrate **10** may be joined with any material as long as it affords a good electrical and physical connection, or may be joined using an adhesive material of a conductive joining material (such as solder) instead of the bumps **B1** and **B2**. Examples of the material of the n-side electrode **21** and the p-side electrode **22** include gold, nickel, titanium, and aluminum.

The semiconductor layer **23** is disposed on the n-side electrode **21** and the p-side electrode **22**. The semiconductor layer **23** of this embodiment mainly has a buffer layer **23a**, an n-type semiconductor layer **23b**, an active layer **23c**, and a p-type semiconductor layer **23d**. The buffer layer **23a**, the n-type semiconductor layer **23b**, and the p-type semiconductor layer **23d** can be made from gallium nitride, aluminum gallium nitride, or aluminum nitride, for example, but can also be made from other materials. The active layer **23c** can be made from indium gallium nitride or gallium nitride, for example, but can also be made from other materials. The semiconductor layer **23** has an upper face **23S** and the lower face **23T**. The upper face **23S** is the uppermost layer of the semiconductor layer, and is, for example, the surface of the n-type semiconductor layer or the buffer layer **23a**. The lower face **23T** is the lower face of the n-type semiconductor layer **23b** and the p-type semiconductor layer **23d**.

The reinforcing portion **24** is disposed on the upper face **23S** of the semiconductor layer **23**. The reinforcing portion **24** is made from a light-transmissive material. Sapphire, SiO₂, alumina, or another such inorganic material, or epoxy, silicone, or another such resin, or the like can be used as the light-transmissive material. This reinforcing portion **24** raises the strength at the ends of the semiconductor layer **23**. The reinforcing portion **24** can be formed, for example, in a width of 2 to 20 μm and a height of 2 to 20 μm, and at an angle of about 33 to 55 degrees.

The upper face **23S** of the semiconductor layer includes a center part **23Sc** and an outer edge part **23Se**. The outer edge part **23Se** surrounds the center part **23Sc**. The outer edge part **23Se** is the region within a specific range from the outer edge of the upper face **23S**. The outer edge part **23Se** of this embodiment includes first to fourth outer edge parts **e1** to **e4** that are connected sequentially.

In this embodiment, as shown in FIG. 1, the reinforcing portion **24** has a first reinforcing portion **241** and a second reinforcing portion **242**. The first reinforcing portion **241** is disposed on the first outer edge part **e1**. The second reinforcing portion **242** is disposed on the second outer edge part **e2**. The first reinforcing portion **241** and the second reinforcing portion **242** are connected together. Thus, the majority of the first outer edge part **e1** and the second outer edge part **e2** is covered by the reinforcing portion **24**. The first outer edge part **e1** and the second outer edge part **e2** are examples of the “covered portion” of the upper face **23S** that is covered by the reinforcing portion **24**.

Thus, the reinforcing portion **24** can be formed in an L shape that is continuous along the outer edge on two sides of the upper face **23S**, for example. That is, the reinforcing portion **24** may not be disposed on the third and fourth outer edge parts **e3** and **e4**. Also, the reinforcing portion **24** may not be disposed on the center part **23Sc**. In this embodiment, the third and fourth outer edge parts **e3** and **e4** and the center part **23Sc** of the upper face **23S** of the semiconductor layer **23** are exposed from the reinforcing portion **24**. This suppresses the reduction in light emission caused by the reinforcing portion **24**. The center part **23Sc** and the third and fourth outer edge parts **e3** and **e4** are examples of the “exposed portion” of the upper face **23S** that is exposed from the reinforcing portion **24**.

The surfaces of the third and fourth outer edge parts **e3** and **e4** and the center part **23Sc** of the upper face **23S** of the semiconductor layer **23** are preferably rougher than the surfaces of the first outer edge part **e1** and the second outer edge part **e2**. Specifically, the surface roughness of the third and fourth outer edge parts **e3** and **e4** and the center part **23Sc** is greater than the surface roughness of the outer edge part **e1** and the second outer edge part **e2**. The arithmetic mean roughness Ra or maximum height Ry may be used for comparing surface roughness. This roughness can be obtained by chemically etching the semiconductor layer. This raises the light takeoff efficiency from the light emitting element **20**.

As shown in FIG. 1, the inner edge **24a** of the reinforcing portion **24** may be formed in wavy line pattern (that is, zigzag) in plan view. Specifically, the inner edge **24a** has protrusions in plan view. This is because an end of the sapphire substrate **30** breaks along the shape of the outer edge of convex portions **31** protrusions of the sapphire substrate in the laser liftoff process (see FIG. 5) discussed below. Thus, the reinforcing portion **24** can be simply formed from sapphire by utilizing the convex portions **31**, and as a result the inner edge **24a** of the reinforcing portion **24** has a bumpy (wavy) pattern that corresponds to the layout of the convex portions **31**.

On the other hand, the inner edge **24a** of the reinforcing portion **24** can be easily formed in a straight line by forming the reinforcing portion **24** by some method other than laser liftoff, such as a coating or printing method.

As shown in FIG. 2, the reinforcing portion **24** may be formed in a shape that tapers upward from the upper face **23S**. In other words, the outer edge side of the reinforcing portion **24** may be higher than the inner edge side. The reason for this is that cracks form diagonally from the outer edges of the convex portions **31** toward an inclined side face **30T** (see FIG. 5A) in the laser liftoff process of the sapphire substrate **30** (discussed below). Thus forming the reinforcing portion so that its thickness increases at the ends of the semiconductor layer raises the strength of the semiconductor layer **23** at its ends, where it is particularly susceptible to damage.

The height of the reinforcing portion **24** may be uniform, however, and a cross section of the reinforcing portion **24** may be elliptical, circular, etc. This reinforcing portion **24** can be formed by some method other than laser liftoff (such as a coating or printing method).

As shown in FIG. 2, in this embodiment an underfill material **25** made of resin preferably fills in the space between the substrate **10** and the semiconductor layer **23**. The underfill material **25** is provided to support the semiconductor layer **23**. The underfill material **25** is an insulating material, such as one or more materials selected from among silicone resins, epoxy resins, and fluororesins, for example. A silicone resin with high heat resistance and light resistance is particularly favorable. The light extraction efficiency of the light emitting device **100** may be raised by mixing white titanium oxide, silicon oxide, alumina, or another such filler into the underfill material **25**. Also, since the strength of the underfill material **25** can be raised by mixing in these fillers, the support strength of the semiconductor layer **23** can be raised in the laser liftoff process of the sapphire substrate **30** (discussed below) or after completion of the light emitting device. As a result, reliability is enhanced during use of the light emitting device **100**, and when the substrate **10** is removed.

As shown in FIG. 2, a cut-out **25a** may be formed in the underfill material **25**. As shown in FIG. 2, the cut-out **25a** is preferably formed under the reinforcing portion **24**. Specifically, in a plan view of the upper face **23S**, the reinforcing portion **24** is preferably formed at a position that overlaps the cut-out **25a**. This increases the strength of the unsupported

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portion of the semiconductor layer **23** at the cut-out **25a** (that is, the portion susceptible to damage).

Method for Manufacturing Light Emitting Device **100** and Light Emitting Element **20**

A method for manufacturing the light emitting device **100** and the light emitting element **20** pertaining to an embodiment will now be described through reference to the drawings. FIGS. **3** to **5** are schematic diagrams illustrating a method for manufacturing the light emitting device **100** and the light emitting element **20**.

First, a plurality of light emitting elements **20** with attached sapphire substrates **30** are manufactured. As shown in FIG. **3A**, a sapphire substrate **30** is readied as a growth substrate for the semiconductor layer **23**. A plurality of convex portions **31** are formed on the main face **30S** of the sapphire substrate **30**. The convex portions **31** can be in the form of a substantially triangular truncated pyramid (with a height of 3 μm and a pitch of about 1 μm , for example), and these convex portions **31** can be provided in a matrix on the main face **30S** of the sapphire substrate **30**. Because protrusions are formed on the upper face **23S** of the semiconductor layer **23** according to these convex portions **31**, the light from the light emitting layer of the semiconductor layer **23** can be extracted off more efficiently from the upper face **23S**.

As shown in FIG. **3A**, the sapphire substrate **30** is preferably a single-crystal sapphire inclined substrate in which the crystal axis is inclined with respect to the main face **30S**. This sapphire substrate **30** has the inclined side face **30T** on its side face. This makes it easy to form the reinforcing portion **24** in a shape in which the height is greater at the ends of the semiconductor layer **23**.

As shown in FIG. **3B**, the buffer layer **23a**, the n-type semiconductor layer **23b**, the active layer **23c**, and the p-type semiconductor layer **23d** are then formed in that order on the main face **30S** of the sapphire substrate **30** by MOVPE (metalorganic vapor phase epitaxy) method, for example.

As shown in FIG. **3C**, the p-side electrode **22** is then formed on the p-type semiconductor layer **23d** by vacuum vapor deposition, for example.

As shown in FIG. **4A**, the p-side electrode **22**, the p-type semiconductor layer **23d**, and the active layer **23c** are then removed to expose part of the n-type semiconductor layer **23b**.

As shown in FIG. **4B**, the n-side electrode **21** is then formed on the exposed part of the n-type semiconductor layer **23b** by vacuum vapor deposition, for example.

Next, the sapphire substrate **30** (which is roughly 80 to 200 μm thick) and the semiconductor layer **23d** is divided up into individual units having a specific size (rectangular pieces measuring from 500 to 2000 μm along one side in plan view, for example) to obtain light emitting elements **20** with sapphire substrates **30** by breaking and/or scribing. These individual sapphire substrates **30** have the inclined side face **30T**.

The resulting light emitting element **20** with the attached sapphire substrate **30** is then mounted on the substrate **10**.

As shown in FIG. **4C**, the n-side electrode **21** is connected to the n-side wiring electrode **12** of the substrate **10**, and the p-side electrode **22** is connected to the p-side wiring electrode **13** of the substrate **10**, via the bumps **B1** and **B2**.

As shown in FIG. **5A**, the space between the substrate **10** and the semiconductor layer **23** is then filled with an underfill material, and the portion of the underfill material that sticks out from the side face of the semiconductor layer **23** is blasted away for forming the underfill material **25**. Here, since the underfill material is easily blasted away on the inclined side face **30T** side of the sapphire substrate **30**, the cut-out **25a** is formed in the underfill material **25**.

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As shown in FIG. **5B**, the semiconductor layer **23** is then irradiated from the sapphire substrate **30** side with laser light transmitted by the sapphire substrate **30** (such as a KrF excimer laser), which brings about a decomposition reaction in the semiconductor layer **23** and separates the sapphire substrate **30** from the semiconductor layer **23**.

In this irradiation, since part of the laser light is reflected and refracted at the inclined side face **30T** of the sapphire substrate **30**, the decomposition reaction of the semiconductor layer **23** does not proceed well at the first outer edge part **e1** and the second outer edge part **e2** of the upper face **23S** of the semiconductor layer **23**. As a result, part of the sapphire substrate **30** near the inclined side face **30T** ends up still adhering to the upper face **23S**, which forms the first reinforcing portion **241** on the first outer edge part **e1**, and forms the second reinforcing portion **242** on the second outer edge part **e2**. The sapphire substrate **30** here is split by cracks formed diagonally from the outer edges of the plurality of convex portions **31** toward the inclined side face **30T**. FIG. **6** is a SEM image of a reinforcing portion **24** that was actually produced.

As discussed above, the light emitting element **20** in this embodiment comprises a reinforcing portion **24** that is disposed on the outer edge part **23Se** of the upper face **23S** of the semiconductor layer **23**. Therefore, damage to the ends of the light emitting element **20** (and particularly the semiconductor layer **23**) can be suppressed.

The reinforcing portion **24** is preferably formed along the outer edge of the upper face **23S**. Specifically, the reinforcing portion **24** preferably does not cover the center part **23Sc** of the upper face **23S**. This suppresses the reduction in emitted light by the reinforcing portion **24**.

The underfill material **25** preferably has the cut-out **25a** formed on the opposite side of the reinforcing portion **24**, with the semiconductor layer **23** in between. This increases the strength of the unsupported portion of the semiconductor layer **23** by the cut-out **25a**. Also, compared to when the reinforcing portion **24** is formed all the way around the outer edge part **23Se**, there is less reduction of emitted light by the reinforcing portion **24**.

The inner edge **24a** of the reinforcing portion **24** is preferably formed in a wavy line having protrusions. The reinforcing portion **24** can be formed more simply than when a method other than laser liftoff is used, for example, by forming the reinforcing portion **24** by utilizing the convex portions **31** of the sapphire substrate **30** in the laser liftoff process.

The outer edge side of the reinforcing portion **24** is preferably higher than the inner edge side. This increases the strength of the semiconductor layer **23** at its ends, where it is particularly susceptible to damage. Also, there is less reduction of emitted light by the reinforcing portion **24** than when the reinforcing portion **24** is formed in a uniform height.

Other Embodiments

The embodiment is described above, but the text and drawings that form part of this disclosure should not be construed as limiting this invention.

In the above embodiment, the reinforcing portion **24** is formed only on the first outer edge part **e1** and the second outer edge part **e2** of the upper face **23S** of the semiconductor layer **23**, but this is not the only option. The reinforcing portion **24** may also be formed on the third outer edge part **e3** or the fourth outer edge part **e4**. The reinforcing portion **24** is not, however, disposed on the center part **23Sc**.

In the above embodiment, the reinforcing portion **24** is formed by laser liftoff process of the sapphire substrate **30**, but this is not the only option. The reinforcing portion **24** can be formed by applying a light-transmissive material by coat-

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ing, printing, or the like over the outer edge part 23Se of the upper face 23S after the laser liftoff process of the sapphire substrate 30.

In the above embodiment, the semiconductor layer 23 has the buffer layer 23a, the n-type semiconductor layer 23b, the active layer 23c, and the p-type semiconductor layer 23d, but this is not the only option. The semiconductor layer 23 need not have the buffer layer 23a. Also, the light emitting element may be such that the semiconductor layer 23 comprises the p-type semiconductor layer 23d, the active layer 23c, and the n-type semiconductor layer 23b laminated in that order over the sapphire substrate 30, and the p-type semiconductor layer is the upper face.

As shown in FIG. 7, the convex portions 31 can be in the form of a triangular truncated pyramid in which the sides bulge outward and the top is flat. As shown in FIG. 8, the convex portions 31 can also be in the form of a triangular pyramid in which the sides bulge outward and the top is pointed. Furthermore, the convex portions 31 can be in the form of tetragonal or higher polygonal truncated pyramids, or tetragonal or higher polygonal pyramids. The height of the convex portions 31 can be from 1.0 to 1.7 μm .

Also, the triangular lattice layout shown in FIG. 9, the square lattice layout shown in FIG. 10, as well as a parallelogram lattice layout, a rectangular lattice layout, or the like can be employed for the layout of the plurality of convex portions 31. The convex portions 31 need not be laid out in a regular pattern, but are preferably disposed so that they are uniformly separated from each other. The spacing between the apexes of the convex portions 31 is preferably from 2.2 to 3.1 μm , and more preferably from 2.8 to 3.1 μm . Thus setting the spacing of the apexes increases the crystallinity of the semiconductor layer 23 grown on the sapphire substrate 30, and raises the light extraction efficiency of the light emitting device 100.

In the above embodiment, the substrate 10 comprises the substrate main body 11, the n-side wiring electrode 12, and the p-side wiring electrode 13, but this is not the only option. As long as the light emitting element 20 can be mounted, the substrate 10 need not have the substrate main body 11, and may be a lead frame having only the n-side wiring electrode 12 and the p-side wiring electrode 13.

Also, the light emitting device of the present invention may have a sealing member for sealing the light emitting element 20, the substrate 10, etc. This improves the reliability of the light emitting device. A resin material with high translucency, such as silicone or epoxy, can be used as the sealing member.

What is claimed is:

1. A light emitting element disposed on a substrate comprising:

- a semiconductor layer;
 - a pair of positive and negative electrodes disposed on a lower face side of the semiconductor layer, the pair of electrodes connected to the substrate; and
 - a reinforcing portion disposed on an outer edge part of an upper face of the semiconductor layer, the reinforcing portion made from a light-transmissive material; the upper face including an exposed portion exposed from the reinforcing portion, and
- the reinforcing portion is made of sapphire.

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2. The light emitting element according to claim 1, wherein the reinforcing portion is formed along an outer edge of the upper face.

3. The light emitting element according to claim 2, further comprising:

a resin portion arranged to fill a space between the substrate and the semiconductor layer, wherein the resin portion has a cut-out below the reinforcing portion.

4. The light emitting element according to claim 3, wherein an inner edge of the reinforcing portion has protrusions in plan view.

5. The light emitting element according to claim 4, wherein the reinforcing portion is higher on an outer edge side than on an inner edge side.

6. The light emitting element according to claim 5, wherein the exposed portion is rougher than a covered portion which is covered by the reinforcing portion.

7. The light emitting element according to claim 1 further comprising:

a resin portion arranged to fill a space between the substrate and the semiconductor layer, wherein the resin portion has a cut-out below the reinforcing portion.

8. The light emitting element according to claim 7, wherein an inner edge of the reinforcing portion has protrusions in plan view.

9. The light emitting element according to claim 8, wherein the reinforcing portion is higher on an outer edge side than on an inner edge side.

10. The light emitting element according to claim 9, wherein

the exposed portion is rougher than a covered portion which is covered by the reinforcing portion.

11. The light emitting element according to claim 1, wherein an inner edge of the reinforcing portion has protrusions in plan view.

12. The light emitting element according to claim 11, wherein

the reinforcing portion is higher on an outer edge side than on an inner edge side.

13. The light emitting element according to claim 12, wherein

the exposed portion is rougher than a covered portion which is covered by the reinforcing portion.

14. The light emitting element according to claim 1, wherein

the reinforcing portion is higher on an outer edge side than on an inner edge side.

15. The light emitting element according to claim 14, wherein

the exposed portion is rougher than a covered portion which is covered by the reinforcing portion.

16. The light emitting element according to claim 1, wherein

the exposed portion is rougher than a covered portion which is covered by the reinforcing portion.

17. A light emitting device, comprising:

the light emitting element according to claim 1; and the substrate on which the light emitting element is mounted.

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